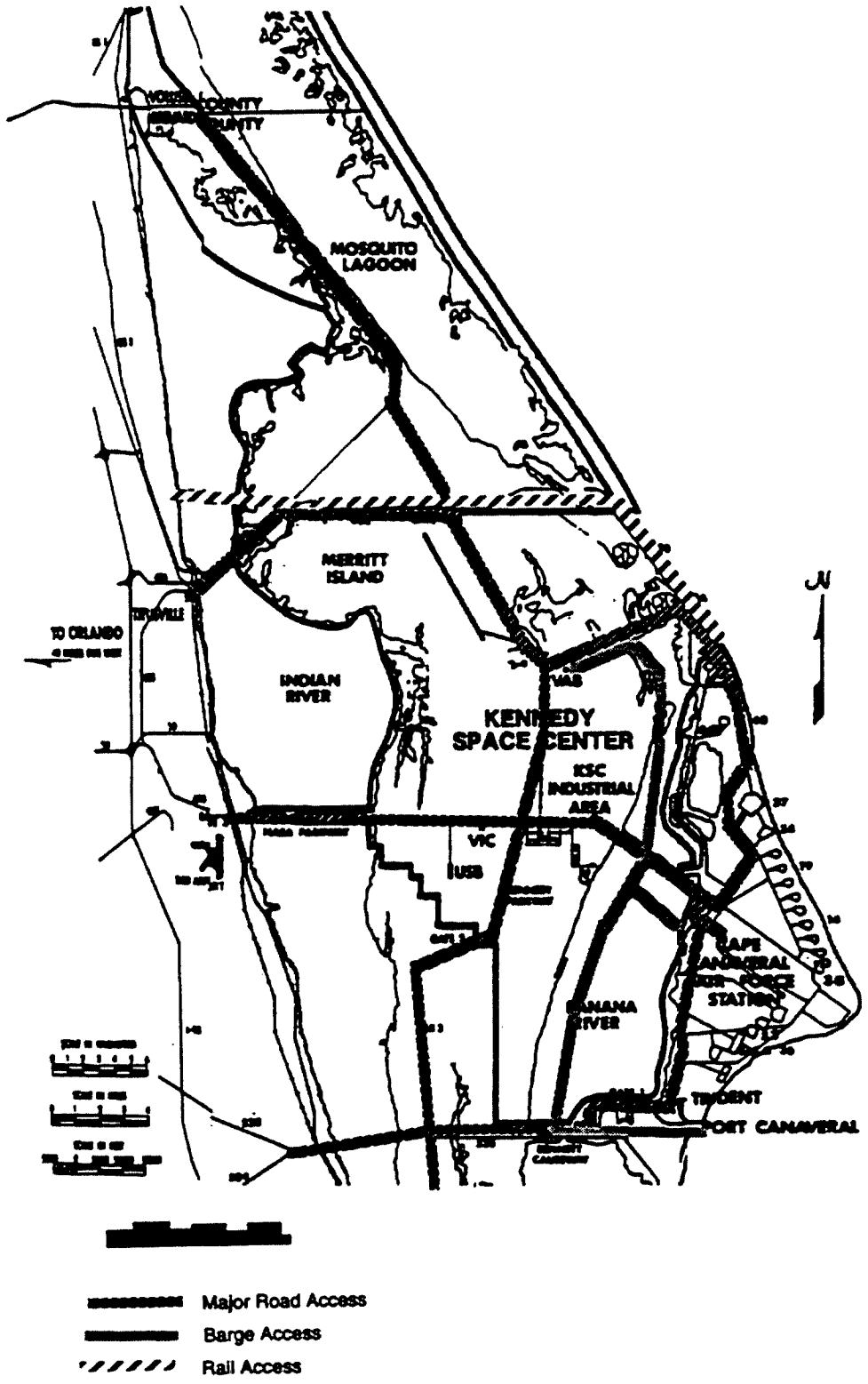

Figure 3.1-10. KSC and CCAS Transportation Map

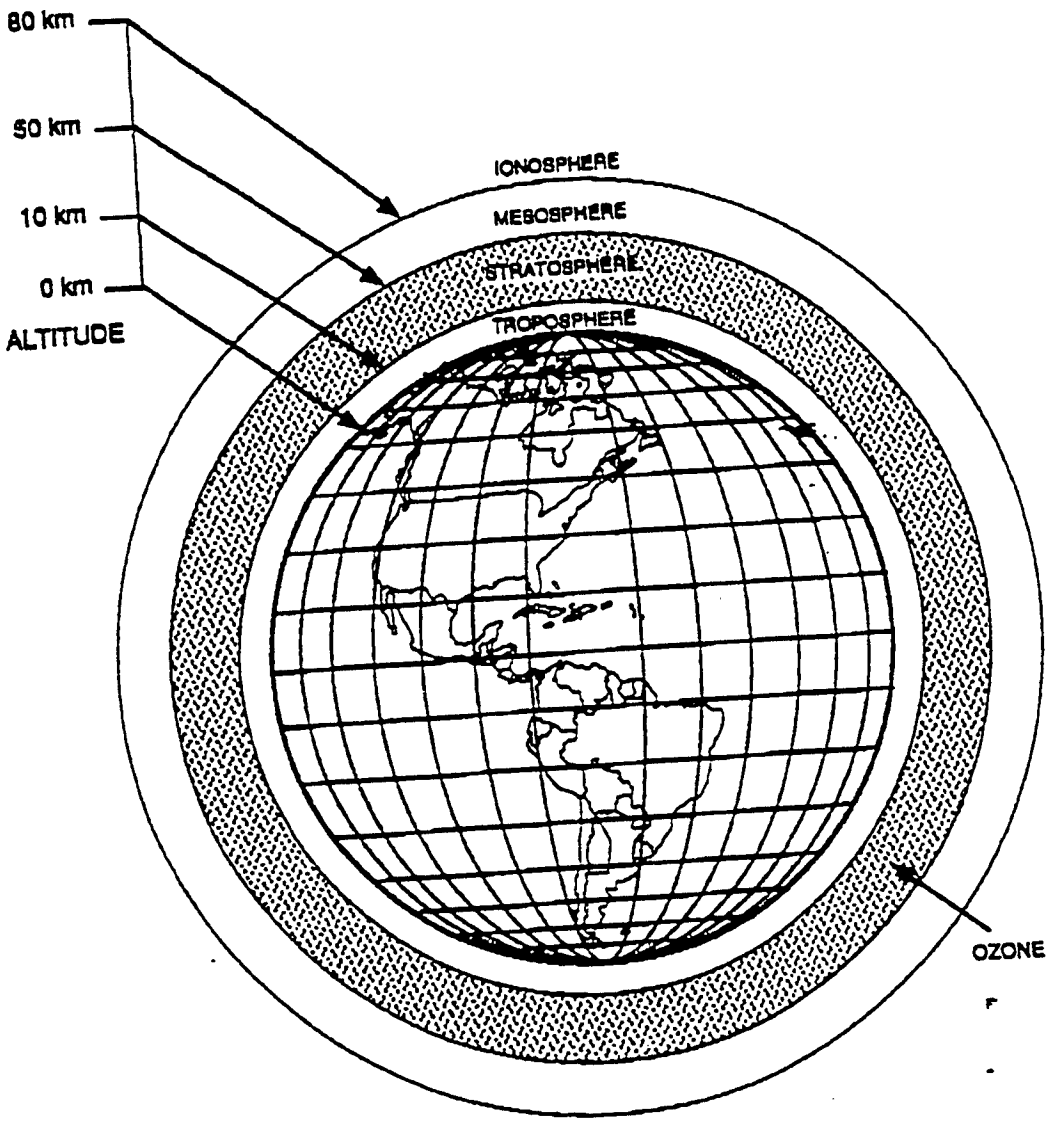

Figure 3.2-1. Location of the Earth's Atmospheric Layers

3.2.1 Troposphere

The troposphere extends from sea level to approximately 10 km (6 mi) of altitude. A global concern to the troposphere is the "greenhouse effect." Shortwave light or radiation from the Sun is transmitted through all atmospheric layers to the Earth's surface, where it heats the Earth and its atmosphere, resulting in the emission of long-wave (infrared) radiation. Part of the outgoing infrared radiation is trapped by trace gases in the troposphere, an effect called "greenhouse warming." Manmade gases, especially carbon dioxide, have been increasing in concentration. Concern that significant increases in "greenhouse gases" will elevate the Earth's average temperature and negatively affect or alter the natural balance of our ecosystems has resulted in panels being formed to address "greenhouse warming" issues (NAS 1991).

3.2.2 Stratosphere

The stratosphere contains the "ozone layer" which protects Earth's biological systems—plants, animals, and humans—from dangerous ultraviolet-B (UV-B) light which can cause skin cancer, cataracts, and other genetic alterations (NAS/NRC 1984, EPA 1987, Monastersky 1990). The stratosphere spans an altitude range of approximately 10 km (6 mi) to 50 km (30 mi). This atmospheric layer has been the subject of intensive research due to scientific theories, projections, and preliminary evidence that manmade chemicals, especially chlorofluorocarbons such as freon, are reducing ozone concentrations in the stratosphere. (Molina/Rowland 1974, NAS/NRC 1984, WMO 1985, WMO 1989, WMO 1991, WMO 1994)

Worldwide concern led to the first international meeting in Montreal, Canada, in 1987, devoted to understanding and policy formulation of protection of the stratosphere. Currently, ninety-two (92) countries, including the U.S., are parties to the "Montreal Protocol."

4.0 Environmental Consequences and Mitigation

4.1 Summary of Relevant Issues and Status of Issues

Impacts of the X-33 Program at each proposed takeoff site and on the global environs vary from none to potentially wide-ranging. Results of the analyses are summarized in Table 4.1-1.

Impacts were classified in one of six categories:

- Not Applicable (N/A) - those activities not related to the site specific or global environment
- None - those areas in which no impacts are expected
- Minimal - those areas in which the impacts are not expected to be measurable or are too small to cause any degradation to the environment
- Minor - those impacts which will be measurable but are within the capacity of the impacted system to absorb the change or can be compensated for with little effort and resources so that the impact is not substantial
- Major - those environmental impacts which individually or cumulatively could be substantial
- EA-II - those issues which, through lack of design data and/or proposed operational plans, could not be analyzed

Those issues classified in one of the first four categories will not be addressed in subsequent NEPA documentation except to describe specific mitigation to ensure that environmental impacts for that medium will not be substantial or major.

4.2 Takeoff Control and Support Operations (Primary Sites)

4.2.1 Facilities and Infrastructure

All three ranges which are considered reasonable alternatives are large test facilities employing thousands of Government and contractor personnel. In order to perform their assigned functions, they have established a substantial infrastructure to support test and day-to-day activities.

Wastewater Treatment

EAFB operates three separate wastewater collection and treatment facilities serving various portions of the base. The Main Base facility, with a design capacity of 5.7 mLd (1.5 mgd), is currently treating an average of 6.3 mLd (1.7 mgd). In order to alleviate the capacity shortage, a new tertiary treatment plant will be put in service in 1996. The new plant is designed to treat

Table 4.1-1. X-33 Relevant Issues and Status of Issues Matrix

ISSUES	EAFB	WSMR	ER	OFF-RANGE/ GLOBAL
Facilities and Infrastructure (Combined)	Minimal	Minimal	Minimal	EA-II
Wastewater Treatment	Minimal	Minimal	Minimal	EA-II
Electricity	Minimal	Minimal	Minimal	EA-II
Communications	Minimal	Minimal	Minimal	EA-II
Natural Gas	Minimal	Minimal	Minimal	EA-II
Fuel	Minimal	Minimal	Minimal	EA-II
Hazardous Waste	Minimal	Minimal	Minimal	EA-II
Nonhazardous Solid Waste	Minimal	Minimal	Minimal	EA-II
Air Quality (Combined)	Minor	Minor	Minimal	EA-II
Airspace				
On-Range Flights	None	None	None	N/A
Off-Range Flights in Range-Controlled Airspace	Minimal	Minimal	Minimal	Minimal
Off-Range Flights Outside of Range-Controlled Airspace	N/A	N/A	N/A	EA-II
Biological Resources (Combined)	Minimal	Minimal	Minor	EA-II
Threatened, Endangered, and Sensitive Species	EA-II	EA-II	EA-II	EA-II
Cultural Resources	EA-II	EA-II	Minimal	EA-II
Water Resources				
Domestic/Industrial	Minimal	Minimal	Minimal	EA-II
Takeoff Deluge	Minor	Minor	Minimal	EA-II
Geology and Soils	Minimal	Minimal	Minimal	EA-II
Hazardous Materials				
Contamination	Minor	None	Minor	EA-II
ES/QD's	None	None	None	EA-II
Transportation	None	None	None	EA-II
Health and Safety				
Flight Safety	Minimal	Minimal	Minimal	EA-II
Non-Flight Safety	None	None	None	EA-II
Land Use	None	None	None	EA-II
Operational Noise	Minimal	Minimal	Minimal	EA-II
Transportation	Minor	Minimal	None	EA-II
Population and Employment	Minimal	Minimal	Minimal	EA-II
Flight Noise and Sonic Booms	None	None	None	EA-II
Off-Site Safety (Overflight)				
Flight Safety	EA-II	EA-II	EA-II	EA-II
Non-Flight Safety	EA-II	EA-II	EA-II	EA-II
Troposphere	None	None	None	None
Stratosphere (Ozone)	None	None	None	Minimal

Key to the Categories:

N/A: The issue has no relevance to the site or global environs.

None: There are no impacts expected.

Minimal: The impacts are not expected to be measurable or are too small to cause any degradation to the environment.

Minor: Those impacts which are measurable but are within the capacity of the impacted system to absorb the change, or the impacts can be compensated for with little effort and resources so that the impact is not substantial.

Major: Those environmental impacts which individually or cumulatively could be substantial.

EA-II: Those issues which, through lack of design data and/or proposed operational plans, could not be analyzed. Further discussion of these items is deferred to EA-II.

9.5 mLd (2.5 mgd), which should alleviate current and projected future capacity problems. The other two systems are operating within respective design capacities.

WSMR operates a sewage collection and treatment plant which treats both industrial and domestic wastewater generated on the Main Post. There are also smaller sanitary facilities serving outlying areas. The Main Post system and SRC plant area are currently operating at 50 and 20 percent of respective capacities.

KSC operates five domestic WWTP's which currently operate at less than 50 percent capacity. The facility of primary interest to the X-33 Program is the KSC LC-39 holding tanks. The system is designed to handle sound suppression, fire suppression, and postlaunch washdown water from Space Shuttle launches. This volume of water is considerably larger than that expected to be generated during X-33 takeoff. CCAS has 15 WWTP's which will be replaced by a new plant currently under construction. The new plant will have sufficient capacity to treat current wastewater in addition to deluge water from launch operations, while still having excess capacity for expected demand increases.

Wastewater impacts from the X-33 Program will consist of two types: domestic wastewater resulting from additional personnel and industrial wastewater resulting from processing and launch operations. It is anticipated that during site preparation and flight test operations, approximately 100 additional people will be working on the range. Compared to normal range populations, this increase is minimal. Industrial wastewater will result from X-33 spaceplane cleaning operations; spaceplane processing and repair, such as TPS repairs; and water deluge/sound suppression systems used during takeoff. No new processes are involved; therefore, wastes are expected to be similar to those resulting from normal launch operations. Since all three ranges either have or shortly will have substantial excess treatment capacity, and the amount of extra wastewater involved is minimal compared to the normal daily water use on the ranges, the impact will be minimal.

Electricity

All three ranges receive electricity from commercial utilities in their areas. All have excess capacity as well as some emergency backup capability through the use of Government-owned electric generators on-site. The proposed EAFB sites will require extension of electric lines. The Nike Avenue and WSSH sites at WSMR and both ER sites already have electricity. The increase in demand for electricity due to the X-33 Program will be minimal in comparison to existing demand on each range. The only potential impact may be from extending power lines to the takeoff site. Overall impact will be minimal.

Communications

All three ranges have telephone and radio networks in place. The EAFB C4 has the capability to provide virtually limitless support. Only 4 of the 48 strands of a fiberoptic loop are used for the telephone system, leaving 44 strands for computer networking and future growth. WSMR has telephone and data transmission service at the existing takeoff sites. Both ER sites have existing telephone service and communication systems capable of transmitting large volumes of data from test and takeoff operations. Overall impact at each range will be minimal.

Natural Gas

Most of EAFB, WSMR, and ER have natural gas service available. A pipeline to provide service to CCAS will be constructed in the 1996-1997 timeframe. There will be minimal impact to natural gas service since X-33 Program requirements will be minimal, if any.

Fuel

All three ranges operate large fleets of vehicles and maintain adequate fuel storage and dispensing facilities to support them. The number of vehicles required to support the X-33 Program will be minimal in comparison and should result in very minimal impact.

The three ranges also maintain storage and dispensing capabilities for aviation fuels. The only potential impact involves weather observation and chase planes during test, and transport aircraft returning the spaceplane to the takeoff site. Due to the limited number of test flights, impact to aviation fueling should be minimal compared to aviation support for ongoing test activities.

PL at EAFB has had some experience, and will shortly have extensive experience, with both LH_2 and LOX. Some infrastructure is in place and more is being readied. Currently PL is conducting a program to run hydrostatic bearings in LH_2. In addition, a number of LH_2/LOX engines are scheduled to be tested during the next year.

WSMR has had some limited experience with LH_2 and LOX as a result of various test programs, but quantities have been small and on-site storage accommodated with portable tanks. WSMR does not have permanent infrastructure other than portable tanks to support LOX/LH_2 fuel requirements. WSMR personnel have been working with WSTF in order to gain the required expertise and have identified necessary equipment. Fuel impacts are anticipated to be minimal at WSMR.

At the ER, LOX and LH_2 are used in large quantities to boost the Space Shuttle and other large expendable launch vehicles. Permanent storage and delivery systems are in place at KSC LC-39. Propellant storage and delivery would have to be accommodated at SLC-37. The X-33 will use approximately 95,000 kg (210,000 lbs) of propellant (LOX and LH_2 combined). This amount is minimal compared to that utilized by the Space Shuttle (approximately 730,000 kg (1,610,000 lbs) of LOX and LH_2), and Atlas Rocket (approximately 172,000 kg (379,195 lbs) of LOX and RP-1); therefore, the impact will be minimal..

Fuel-related impacts from motor vehicles, aircraft operations, and operation of the X-33 spaceplane will be minimal at all three ranges.

Hazardous Waste

Hazardous wastes from site preparation activities generally result from sandblasting, painting, and cleaning operations. For site preparation activities, such wastes can be expected to be produced. However, given the magnitude and type of effort required, these wastes should be minimal in volume and similar in nature to those currently generated at the three proposed primary sites.

Therefore, existing collection and disposal systems at each site are expected to be able to accommodate the wastes.

Spaceplane manufacturing and operation will also produce hazardous waste largely from component cleaning and related system processing operations. These types of operations already occur at all three sites, and the volumes from this program are expected to produce only minimal changes to the current totals.

EAFB has storage capacity for approximately 153,000 L (40,500 gal) of hazardous waste and currently operates at an average of 50 percent capacity, allowing considerable capability for future requirements.

WSMR has established a central facility for storage and distribution of hazardous materials. WSMR also has a central hazardous waste storage facility where the wastes are properly manifested to an off-site contract disposal facility. Disposal of hazardous waste generated during site preparation, on-site spaceplane processing, and flight operations will be handled by this facility.

Spaceplane operations will also result in some volume of residual fuel (LH_2 and LOX) to be removed immediately after each flight. The amount will depend on the specific spaceplane. All three proposed sites are able to handle both fueling operations and removal of residual fuels using safe procedures to vent these gases to the atmosphere.

Hazardous waste generated by the X-33 Program will result in minimal impact at all three ranges.

Solid Waste

The primary disposal method of nonhazardous solid waste, including residential, construction/ demolition, commercial, industrial and yard waste, is in landfills located on the ranges. EAFB operates one landfill and a recycling facility. WSMR operates three landfills. KSC recently opened a new landfill and operates its own recycling facilities. CCAS maintains its own landfill for construction and demolition debris generated from Air Force projects, plus sends some waste off-site. Solid waste generated by the X-33 Program will consist of a relatively minimal amount of debris and waste generated by the 100 test program personnel during normal operations. The amount of waste will be minimal compared to the waste produced daily by regular base operations; therefore, the impact will be minimal at all three ranges.

Combined Facilities and Infrastructure Impacts

The X-33 Program would result in minimal combined facilities and infrastructure impacts. These impacts and their severities vary by range. It is anticipated that all of the identified infrastructure impacts could be compensated for with minimal effort and resource expenditure or would be of so little consequence that no compensation would be required.

4.2.2 Air Quality

Impacts to air quality may result from four activities of the X-33 Program: site preparation activities, new or modified stationary air emission sources, increased mobile sources such as vehicular traffic, and emissions from the X-33 spaceplane exhaust. Each air quality impact will be discussed separately.

Site preparation activities generally produce air pollutant emissions in the form of particulate matter (dust) from earth moving actions, and hydrocarbons and particulates from site preparation vehicle exhausts. Regardless of the site, such activities are expected to be minimal in scope and of short duration. Facilities required for this program are few, and the land required is relatively small (maximum of 4 ha (10 ac)). Additionally, emissions from earth moving can be mitigated by using Best Management Practices (BMP's), such as water spraying, placement of hay bales in desert areas, and other forms of dust control. The number of site preparation vehicles is also expected to be relatively small. Therefore, impacts from these activities are expected to be minimal.

The X-33 Program plans to only produce one technology demonstration vehicle. Therefore, there will be no need for new or greatly increased production facilities which would have air pollution sources. Neither will the new or expanded facilities at the selected primary site require addition or enhancement of major stationary air pollution sources. The takeoff pad itself would not contain any air sources other than venting from stationary LH_2 or LOX storage tanks or emergency power generators. The former involves no regulated air pollutants, while the latter would produce only minimal amounts of emissions at irregular intervals. Therefore, only minimal impacts to air quality are expected from these sources.

The number of commercial vehicles required for operations is small. These do not represent a major increase in traffic other than that already experienced by the potential sites. The number of personnel required is also small (less than 100). The increase in vehicle loading is not expected to be measurable; therefore, these sources are expected to produce only minimal impacts to air quality at any of the sites.

The last category of emission sources is the exhaust from the X-33 spaceplane itself. The only propellants that will be used are LH_2 (fuel) and LOX (oxidizer). These propellants produce only water as a byproduct of combustion. Water is not a regulated air pollutant and does not pose any threat to air quality regardless of the site selected.

Since the sole combustion product of the X-33 spaceplane is water and the use of solvents in the volatile organic compound family of chemicals will be minimal, no conformity determination for air quality is needed.

EAFB and WSMR could have a potential impact from dust blown into the air during takeoff. There is a possibility that enough dust could be put into the air that air quality standards for a localized area within the ranges would temporarily be exceeded. Implementation of standard dust control procedures would reduce the impact to minor. Due to the existing environment at the ER, this impact is not a concern.

In summary, no potential air pollution impacts from the X-33 Program are of sufficient size, type, or scope to produce major impacts to local air quality regardless of primary site selected. Due to dust generated during takeoff, minor impact to air quality at WSMR and EAFB is expected. Air quality impacts at the ER will be minimal.

4.2.3 Airspace

On-Range Flights

At EAFB, R-2508 occupies over 32,000 sq km (20,000 sq mi) in an area approximately 274 km (170 mi) long north to south and ranging in width from approximately 111 to 163 km (69 to 142 mi) east to west. There are several small towns as well as military housing centers on EAFB; the Naval Air Weapons Center, China Lake; and the National Training Center, Fort Irwin. Flight paths within this airspace will be planned to minimize exposure to these population centers.

WSMR controls 13 designated restricted airspace areas covering all of the range and some surrounding areas. In order to keep the X-33 initially away from population centers, flight will be restricted to the range and range call-up areas. This area is approximately 225 km (140 mi) in length south to north and 97 km (60 mi) in width east to west.

Due to expendable rocket and Shuttle launch operations, the ER has a substantial amount of restricted and controlled airspace. The largest block of restricted airspace is R-2934. It is approximately 81 km (50 mi) long north to south and 48 km (30 mi) wide east to west. There is also a special controlled area, FAR 91.143, extending approximately 81 km (50 mi) off the coast to support Shuttle operations. A warning area, W-497A, extends over the Atlantic Ocean for the length of the range. Due to the coastal nature of the proposed takeoff sites, X-33 flights would be almost totally over water, resulting in no potential impacts to population centers.

Since the ranges have been established for the purpose of flight testing and/or operational flights of aerospace vehicles, impacts to airspace availability within the range are part of normal operations. There are no expected on-range airspace impacts.

Off-Range Flights/Return Landing

Off-range flights in range controlled airspace may occur for flights returning to land at the same range as takeoff. Several commercial, military, and general aviation airfields in the vicinity of all three ranges use the ranges' controlled airspace by permission. Flights scheduled to pass through this airspace, as well as flights departing from affected airfields, may be delayed. However, as the flight window is expected to be of short duration (approximately 15 minutes), these impacts will be minimal. With brief flight times coupled with the low frequency of test flights, it is expected that impacts to non-range air traffic using range-controlled airspace will be minimal.

Off-Range Flights Outside of Range-Controlled Airspace

Current projections are that all X-33 flight out of range-controlled airspace and involving overflight of public property will be above 18,000 m (60,000 ft) or the altitude cutoff for positive control airspace (PCA) by the FAA. Notice of flight plans will be made by the appropriate range safety